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Trends of a Mountain Pine Beetle Outbreak in a High Elevation Site in Yellowstone National Park

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INTRODUCTION

Lodgepole pine, Pinus contorta Dougl., stands have incurred heavy losses in Yellowstone National Park and on the adjoining Targhee National Forest as a result of a massive mountain pine beetle, Dendroctonus ponderosae Hopkins, outbreak. The infestation started on the Targhee National Forest in the late 1950's, spread into the southwestern corner of the Park in 1966, and into stands at higher elevations to the north and east in subsequent years.

Tree losses were measured from the beginning to the end of the infestation in the southwestern portion of the Park (6,400 feet in elevation) to gain insight into yearly trends (Parker, 1973). This information improved our understanding of outbreaks, but additional data were needed, especially for stands at higher elevations. The purpose of this report is to document the information collected in a 320-acre lodgepole pine tract at about 8,300 feet in elevation between North Fork and Middle Fork of Split Creek (Figure 1, Appendix). Tree losses have been recorded since the beginning of the outbreak in 1970.

METHODS

Thirty-two half-acre rectangular plots (0.5 chains by 10 chains) were permanently established in a systematic design within the study tract to measure yearly mortality. The center lines of plots were marked with stakes at 100-foot intervals. The boles of beetle killed and infested trees on the plots were marked by year of attack with metal tags at 4.5 feet above the ground. These plots will be measured yearly until the infestation subsides.

Thirty-two variable plots (10 basal area factor) were located systematically at 10-chain intervals to measure the stand structure. The plot center was marked with a stake and the nearest tree was marked with paint. Plots were remeasured in 1973 to check the 1972 cruise.

RESULTS AND DISCUSSION

Before the outbreak reached the survey tract, there were about 128 live trees per acre 5.5 inches in diameter and above (Table 1,

Appendix). The species composition and density were as follow: P. contorta, 114.1; Pinus albicaulis Engelm., 4.0; Abies lasiocarpa (Hook.) Nutt., 9.7; and Picea engelmannii Parry, 0.5[1/]. Generally, the P. contorta are decadent and dying and there is a high incidence of dwarf mistletoe, arceuthobium americanum, and rot fungi. Reproduction and pole size trees for all species are abundant, but they occur in thick clumps and most of the trees are suppressed.

Cumulatively, the mountain pine beetle killed 5.4 lodgepole pines and 0.7 whitebark pines per acre from 1970 to 1973 (Table 2, Appendix). Three percent of the total stand 5.5 inches in diameter and above was killed. The infestation increased from 0.4 attacks (both hosts) in 1970 to 2.4 in 1971 then tree killing decreased to 1.9 in 1972 and 1.4 in 1973. Attack ratios from one year to the next were as follow: 1971 to 1970, 6:1; 1972 to 1971, 0.8:1, 1973 to 1972, 0.7:1.

Tree losses in the study area have not been as heavy during the first three years as measured in the southwestern corner of the Park (Figure 2, Appendix). Climate probably is the most important factor accounting for lower tree mortality at high versus low elevations because of the effect on the biology of the beetle (Amman, et. al., 1973). Even though there may be an abundant food supply, which would favor a population increase, the beetle is held in check by climatic conditions. Overall, future tree losses in and around the survey area should be well below the level that occurred at lower elevations.

Statistical estimators for sample populations are appended in Table 3.

LITERATURE CITED

Amman, Gene D., Bruce H. Baker, and Lawrence E. Stipe. 1973. Lodgepole Pine Losses to Mountain Pine Beetle related to Elevation. USDA For. Serv. Res. Note INT-171, 8p., illus.

Parker, Douglas L. 1973. Trend of a Mountain Pine Beetle Outbreak. J. Forestry. 71(11):668-670.

1/ Some figures are higher than reported in 1972. Corrections of cruising errors and inclusion of 5, 6 and 7-inch diameter classes for nonhost trees account for the larger figures.

A P P E N D I X

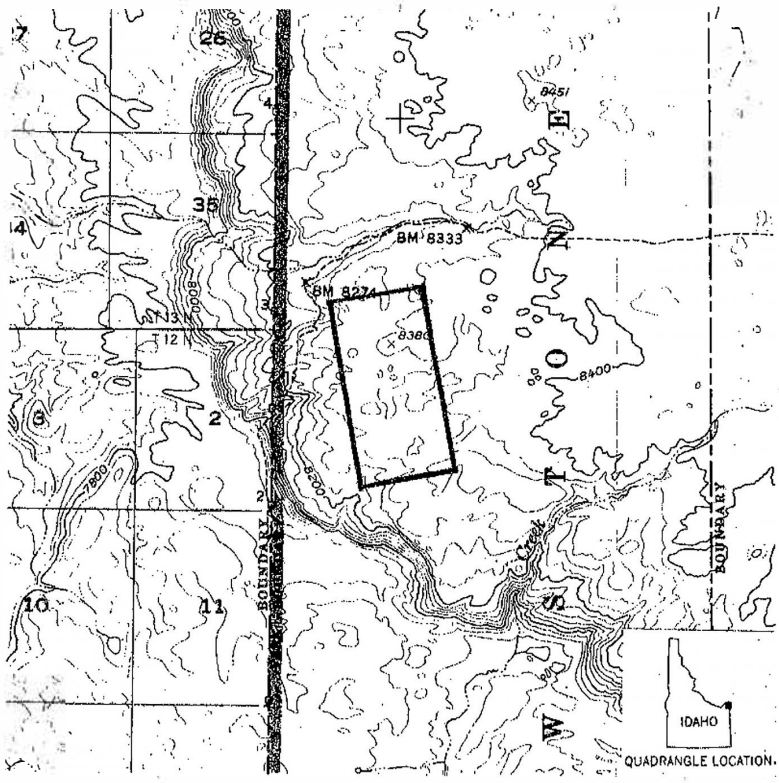

Figure 1. Approximate location of the survey tract in Yellowstone National Park.

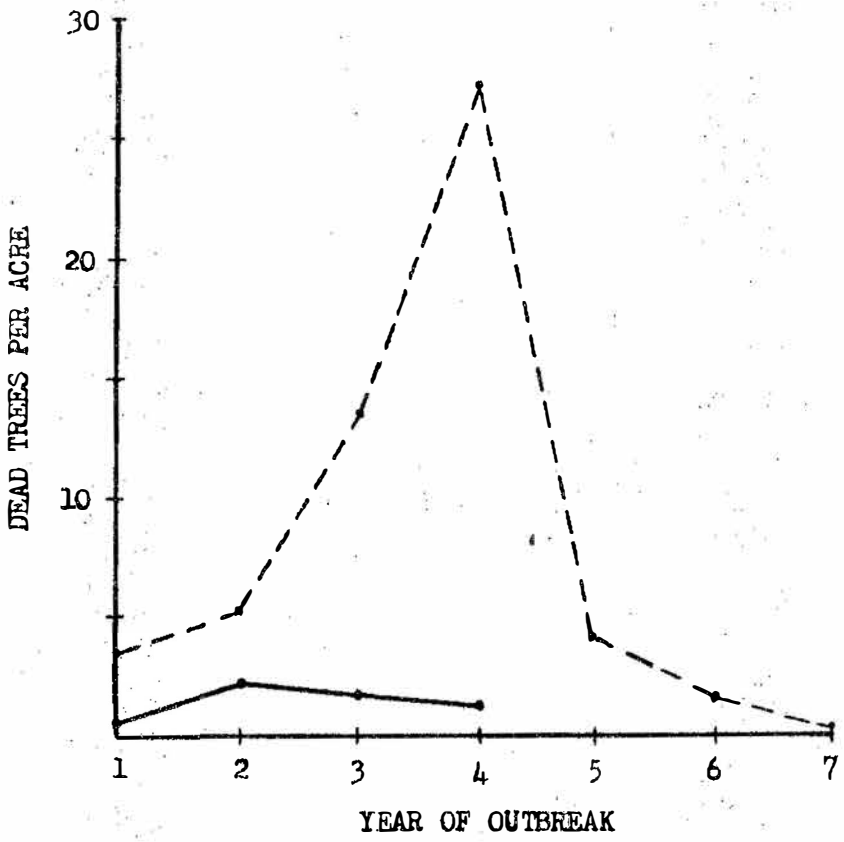

Figure 2. Comparison of yearly mortality figures in trees per acre for a survey conducted in the southwestern corner of Yellowstone National Park (broken line) at 6,400 feet in elevation with the Split Creek survey (solid line) at 8,300 feet in elevation.

Table 1. Stand structure in the survey tract in Yellowstone National Park.

Diameter Class	LIVE TREES PER ACRE						
	Pinus contorta		Pinus albicaulis		Abies lasiocarpa	Picea engelmannii	Total
	1969	1973	1969	1973	1969	1969	1969
6	8.0	8.0	1.6	1.6	3.2	--	12.8
7	7.0	7.0	--	--	1.2	--	8.2
8	7.2	7.1	--	--	0.9	--	8.1
9	8.5	8.4	--	--	0.7	--	9.2
10	9.7	9.7	--	--	--	--	9.7
11	10.9	10.6	0.5	0.5	0.9	--	12.3
12	11.1	10.9	0.4	0.3	0.4	--	11.9
13	10.2	9.9	--	--	1.0	--	10.3
14	9.9	9.6	0.9	0.8	0.6	--	11.4
15	11.7	11.1	0.3	0.1	--	--	12.0
16	6.5	6.0	--	0.0*	0.2	--	6.7
17	5.6	4.8	--	0.0*	--	--	5.6
18	3.0	2.4	--	0.0*	--	--	3.0
19	1.4	1.0	--	--	0.2	--	1.6
20	1.7	1.3	0.1	--	0.3	--	2.1
21	0.5	0.3	--	0.0*	--	--	0.5
22	0.1	0.0	<0.1	<0.1	0.1	--	0.4
23	0.4	0.2	--	0.0*	--	0.1	0.5
24	0.5	0.3	--		--	--	0.5
25	<0.1	<0.1	--		--	--	<0.1
26	--	--	<0.1	<0.1	--	<0.1	0.2
27	--	--	--	--	--	--	--
28	--	0.0*	--	--	--	--	--
29	<0.1	<0.1	--	--	--	<0.1	0.1
30	--	--	--	--	--	--	--
31	--	--	--	--	--	--	--
32	--	--	--	--	--	<0.1	<0.1
33	--	--	<0.1	<0.1	--	<0.1	0.1
34	--	--	--	--	--	--	
35	--	--	--	--	--	<0.1	<0.1
36	--	--	--	--	--	--	--
37	--	--	--	--	--	<0.1	<0.1
TOTAL	114.1	108.7	4.0	3.3	9.7	0.5	128.3

*Dead trees were recorded on mortality plots but not on green stand plots.

Table 2. The number of trees per acre killed by the mountain pine beetle, Dendroctonus ponderosae Hopkins, in Yellowstone National Park.

Diameter Class	TREES PER ACRE							
	Pinus contorta				Pinus albicaulis			
	1970	1971	1972	1973	1971	1972	1973	TOTAL
8	—	—	<0.1	—	—	—	—	0.06
9	—	—	<0.1	—	—	—	—	0.06
10	—	—	—	—	—	—	—	—
11	—	—	0.1	0.1	—	—	—	0.25
12	—	0.1	<0.1	<0.1	<0.1	—	—	0.38
13	<0.1	<0.1	0.1	<0.1	—	—	—	0.31
14	—	—	0.2	0.1	—	<0.1	—	0.38
15	—	0.5	—	0.1	—	<0.1	—	0.69
16	—	0.2	<0.1	0.2	<0.1	<0.1	<0.1	0.63
17	0.1	0.5	0.2	—	<0.1	—	—	0.88
18	0.1	0.1	0.1	0.2	<0.1	—	—	0.63
19	—	—	0.2	0.2	—	—	—	0.38
20	<0.1	<0.1	0.1	0.1	—	—	—	0.37
21	—	0.1	0.1	—	—	—	<0.1	0.31
22	—	<0.1	<0.1	—	<0.1	—	—	0.18
23	—	0.1	—	—	<0.1	—	—	0.18
24	—	<0.1	0.1	—	—	—	—	0.19
25	—	—	<0.1	—	—	—	—	0.06
26	—	—	—	—	—	—	—	—
27	—	—	—	—	—	—	—	—
28	—	<0.1	<0.1	—	—	—	—	0.12
29	—	—	—	—	—	—	—	—
30	—	—	—	—	—	—	—	—
31	—	—	—	—	—	—	—	—
32	—	—	—	—	—	—	—	—
33	—	—	—	<0.1	—	—	—	0.06
TOTAL	0.38	2.00	1.75	1.31	0.38	0.19	0.12	6.14

Table 3. Statistical estimators for sample populations for living host trees, nonhost trees, and annual host tree losses caused by the mountain pine beetle in Yellowstone National Park.

Stand Condition Measured	Mean	Standard Deviation	Standard Error	Confidence Interval (95%)
Pinus contorta 1969	114.14	79.96	14.13	85.32 - 142.96
Pinus albicaulis 1969	3.99	13.51	2.39	-0.88 - 8.86
Abies lasiocarpa 1969	9.69	15.02	2.65	4.29 - 15.09
Picea engelmannii 1969	0.46	2.03	0.59	-0.74 - 1.66
Total Stand 1969	128.28	85.06	15.04	97.60 - 158.96
1970 Tree Losses	0.37	0.94	0.17	0.02 - 0.72
1971 Tree Losses	2.00	2.44	0.43	1.12 - 2.88
1972 Tree Losses	1.75	3.44	0.61	0.51 - 2.99
1973 Tree Losses	1.31	2.52	0.45	0.39 - 2.23